Claims

1. A solenoid, comprising:

first and second armatures each being constructed of a magnetic material;

a core of magnetic material forming a first magnetic circuit with the first armature and a second magnetic circuit with the second armature wherein the first and second magnetic circuits have a common path to the two circuits and wherein each circuit has a exclusive path to the circuit; and

a solenoid coil disposed about a portion of at least one of the circuits.

2. The solenoid as set forth in claim 1, in combination with a drive circuit coupled to the solenoid coil.

3. The solenoid as set forth in claim 2, wherein the drive circuit delivers a first current level to the solenoid coil to move the first armature without substantially moving the second armature and further delivers a second current level greater than the first current level to saturate the path of the first magnetic circuit and cause the solenoid coil to move the second armature.

4. The solenoid as set forth in claim 1, wherein the core of magnetic material includes a first pair of legs disposed on one side of a central member and a second pair of legs disposed on another side of the central member.

5. The solenoid as set forth in claim 4, wherein the legs have a linear shape.

6. The solenoid as set forth in claim 4, wherein the legs have substantially equal cross-sectional sizes.

7. The solenoid as set forth in claim 4, wherein the first pair of legs and the second pair of legs have substantially unequal lengths.

8. The solenoid of claim 1, wherein the core of magnetic material includes a first set of three legs disposed on one side of a central member and a second set of three legs disposed on a second side of a central member.

9. The solenoid of claim 8, wherein the solenoid coil is disposed about a middle leg of the first set of three legs.

10. A solenoid, comprising:

first and second armatures each of magnetic material;

a solenoid core of magnetic material including a central member, first, second and third legs disposed on a first side of the central member such that the second leg is between the first and third legs and fourth, fifth, and sixth legs disposed on a second side of the central member such that the fifth leg is between the fourth and sixth legs, wherein the first armature, the first, second, and third legs comprise a first magnetic circuit and the first, second, third, fourth, fifth and sixth legs and the first and second armatures comprise a second magnetic circuit; and

a solenoid coil disposed about a portion of at least one of the first and second magnetic circuits.

11. The solenoid as set forth in claim 10, in combination with a drive circuit coupled to the solenoid coil.

12. The solenoid as set forth in claim 11, wherein the drive circuit delivers a first current level to the solenoid coil to move the first armature without substantially moving the second armature and further delivers a second current level greater than the first current level to the solenoid coil to saturate the second and fifth legs and direct flux into the second magnetic circuit to move the second armature.

13. The solenoid as set forth claim 12, wherein the first, second, third, fourth, fifth and sixth legs are linear in shape and wherein the first, second and third legs have a first length and the fourth, fifth and sixth legs have a second length substantially unequal to the first length.

14. The solenoid as set forth in claim 10, wherein the solenoid coil is disposed about the second leg only.

15. The solenoid as set forth in claim 10, wherein the first armature forms a first airgap with the first, second and third legs when the solenoid coil is unenergized and wherein the second armature

forms a second airgap with the fourth, fifth and sixth legs when the solenoid coil is unenergized and wherein the first and second airgaps are of equal lengths

16. A fuel injector comprising;

a case portion including a plunger and means to move the plunger in order to pressurize a fluid, a pressurization chamber, a spill valve to control the flow of said fluid from said pressurization chamber, and a direct operated check valve to control a direct operated check;

a nozzle portion including said direct operated check for controlling the injection of said pressurized fluid through at least one orifice in a tip portion of said nozzle; and

a solenoid, located in said case portion comprising first and second armatures each of magnetic material; a solenoid core of magnetic material including a central member, first, second and third legs disposed on a first side of the central member such that the second leg is between the first and third legs and fourth, fifth, and sixth legs disposed on a second side of the central member such that the fifth leg is between the fourth and sixth legs wherein the first armature, the first, second and third legs comprise a first magnetic circuit and the first, second, third, fourth, fifth and sixth legs and the first and second armatures comprise a second magnetic circuit; and wherein a solenoid coil is disposed about a portion of at least one of the first and second magnetic circuits.

17. A method of operating a solenoid that includes first and second armatures each of magnetic material, each located on opposite sides a magnetic core, said magnetic core having a central member, a first set of legs disposed on one side of said central member and a second set of legs disposed on an opposite side of said central member, a solenoid coil, said coil connected to a drive circuit, and a first magnetic circuit formed between said first armature and said first set of legs and a second magnetic circuit formed by said first and second armatures and said first and second sets of legs; the method comprising:

providing a first current level to said coil to activate said first magnetic circuit and move said first armature without substantially moving said second armature; and

providing a second current level to said coil to saturate said first magnetic circuit and activate said second magnetic circuit and move said second armature.

18. The method of claim 17 wherein said second current level is greater than said first current level.

19. A solenoid comprising:

a solenoid core of magnetic material having a central member, a first set of a plurality of legs located on one side of said central member and a second set of a plurality of legs located on the opposite side of said control member, and a coil wrapped around at least a portion of one leg from at least one set of the first and second set of legs;

a first armature located on one side of said solenoid core, and a second armature located on an opposite side of said solenoid core; and

an electrical energy source being adapted to deliver a first current level to said coil such that a first magnetic circuit is activated, thereby moving said first armature without substantially moving said second armature and a second current level such that a second magnetic circuit is activated, thereby moving said second armature.

20. The solenoid of claim 19 wherein a magnitude of said second waveform is greater than a magnitude of said first waveform.